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ON

THECODONTOSAURUS

AND

PALÆOSAURUS.

BY

H. G. SEELEY, F.R.S.

On Thecodontosaurus *and* Palæosaurus.

By H. G. Seeley, F.R.S.*

The well-known memoir by Dr. Henry Riley and Mr. Samuel Stutchbury on three distinct Saurian animals discovered in 1834 in the Magnesian Conglomerate on Durdham Down, near Bristol, was communicated to the Geological Society in 1836, and published in the Transactions of the Society in 1840. Those fossil animals from the Trias became known as *Thecodontosaurus antiquus* (Trans. Geol. Soc. 2nd ser.

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vol. v. pl. xxix. figs. 1 and 2), *Palæosaurus cylindrodon* (*l. c.* fig. 4), and *Palæosaurus platyodon* (*l. c.* fig. 5). The separation of these genera has not been uniformly adopted, though they appear to have been founded upon good characters. In *Thecodontosaurus* the serrations upon the cutting-margins of the teeth are inclined obliquely upward, somewhat like the condition in *Dimodosaurus*. In *Palæosaurus* the corresponding serrations are at right angles to the cutting-margin of the tooth, as in *Megalosaurus*. Therefore the dental characters suggest a possible reference of the fossils to distinct families. But the nature of the serration has not always been accurately represented, since in the British Museum Catalogue of Fossil Reptiles, part i. p. 174, fig. 3, the lateral serrations on the tooth of *Palæosaurus platyodon* are shown as though they were directed obliquely upward; and, in harmony with this figure, the species is referred to the genus *Thecodontosaurus*.

Messrs. Riley and Stutchbury made no attempt to divide the bones which they found between their two genera.

Sir R. Owen, in 1841–42, in the Report of the British Association, recognized a resemblance between the teeth of *Thecodontosaurus*, which he describes correctly, and the teeth of *Rhopalodon* of Fischer, which are serrated in a different way *, though there may be no implication that the serrations are identical, since, while *Thecodontosaurus* is said to have the serrations directed vertically upward, the tooth-crown in *Palæosaurus* is said to be traversed by "two opposite finely serrated ridges, as in *Thecodontosaurus* and *Rhopalodon*."

The authors who first made these animals known described, in addition to teeth and jaw, vertebræ, ribs, chevron-bone, and bones which were regarded as coracoid, humerus, radius, ischium, femur, tibia, fibula, metatarsal or metacarpal bones, and claw-phalanges. Sir R. Owen (*l. c.*) grouped the more important bones under the genus *Palæosaurus*. He recognizes resemblances in the vertebræ to *Teleosaurus* and *Rhynchosaurus*, in the humerus to *Rhynchosaurus*, and in the femur to Crocodiles and *Megalosaurus*. The tooth in both genera is regarded as Lacertian in form, and Thecodont in implantation. The pectoral and probably the pelvic arch are regarded as Lacertian. The double-headed ribs and other vertebral characters, and the proportions of the limbs, are interpreted as Crocodilian.

These animals were afterwards referred to a distinct order under the name Thecodontia; and when they were redescribed in Sir R. Owen's 'Palæontology,' ed. 2, 1861, p. 275, the

* [Trans. Roy. Soc. vol. B cvi. 1894, pl. lxiii. fig. 2.]

comparison with *Rhopalodon* was omitted. An affinity is recognized with Dinosaurs and Crocodiles in the articulation of the ribs by a head and tubercle. The sacrum is said to include at least three vertebræ; and there are said to be obscure indications of a clavicle.

In 1869–70 (Quart. Journ. Geol. Soc. vol. xxvi. p. 42) Prof. Huxley adduced evidence that these animals might be conveniently classed under the Dinosauria, and he doubted their generic separation. In revising the state of knowledge at that time he regarded the teeth of one as Scelidosauroid and of the other as Megalosauroid. All the bones are spoken of as Thecodontosaurian, without attempt to refer them to the two generic types. The coracoid of Messrs. Riley and Stutchbury was interpreted as a fragmentary ilium, and the radius as a tibia. Prof. Huxley may be inferred to have doubted the identification of the ischium, since it is mentioned, like the coracoid and radius, in inverted commas; but no other interpretation is suggested.

Professor v. Zittel has kept these genera separate (Handb. d. Palæontologie, iii. pp. 721, 722), and has given a good figure of the serrations upon the tooth of *Palæosaurus*.

After examining the collection exhibited in the Bristol Museum, I regard the ischium of 1836, which is still embedded in the matrix, as an imperfect example of a humerus. From this it would follow that the deposit contains two types of humerus as well as two types of teeth.

If the specimen of humerus originally figured in 1840 (*l. c.* pl. xxx. fig. 1) is associated with the jaw with vertically serrated teeth as *Thecodontosaurus*, then the humeri nos. 118 and 37, Bristol Museum, and the specimen in question (no. 66) may be the type of another genus, such as is indicated by the teeth of *Palæosaurus*.

If the ilium which Prof. Huxley figured (Quart. Journ. Geol. Soc. vol. xxvi. pl. iii. fig. 7) is accepted as the type ilium of *Palæosaurus*, then the iliac bones preserved in the slab numbered 63 must be referred to two species. That which shows the external aspect of the left ilium is not unlike the specimen just referred to, except that it is smaller. It has the same general form as the ilium of *Zanclodon Quenstedti* (Phil. Trans. Roy. Soc. vol. B xlvi. 1889, p. 283). There is the same kind of open acetabular arch, the same prolongation forward of the pubic pedicle, a like convexity of the superior iliac crest, which has similar anterior and posterior extension. The only differences which could be regarded as specific are that the Bristol fossil has the ischiac pedicle relatively rather wider, and the posterior process of the crest

of the ilium rather longer and deeper, though these differences are no more than might be attributed to age. Since the teeth of *Zanclodon* appear to be of the same general type as that of *Palæosaurus platyodon*, there is strong probability that this ilium is rightly referred to *Palæosaurus*.

The second example in slab 63 is a mould from the internal surface of an ilium. It closely resembles in contour the ilium of an alligator. The acetabulum appears to be more nearly closed than in the first specimen, and the anterior contour of the pubic process is convex from above down, instead of being straight, and it appears to be relatively wider than the ischiac process. Hence, although the bones are right and left, are similar in size and general form, and occur in proximity in the same slab, it cannot be inferred that they belong to the same individual or the same species of *Palæosaurus*.

There is a slab in the Bristol Museum containing a bone which is broken at each of its four extremities, at present without number, which may possibly prove to be the ilium of *Thecodontosaurus* when divested of matrix.

The bones have unfortunately become scattered, so that the unique treasures, which derive their chief value from being naturally associated portions of skeletons, can never again be brought together. The Bristol collection is by far the most important. Some of the bones, like the scapula and femur, differ considerably in size. The bones retained at Bristol comprise dorsal, sacral *, and caudal vertebræ, scapula, and apparently the coracoid, humerus, ulna, metacarpals, ilium, femur, tibia, fibula, metatarsals, and phalanges. The bones which are fairly complete are the ilium, femur, tibia, humerus, and ulna; and upon them the dimensions of the animals must be based.

The Vertebræ.

The vertebræ are short and slender relatively to the length of the limb-bones; and the tail gives no indication of large size of the bodies of the vertebræ, which is seen in some Saurischia.

There is a somewhat elongated specimen in the Bristol Museum named cervical vertebra, which does not show any typical characters of that region of the skeleton. The remaining ten vertebræ are dorsal and caudal. It is impossible to distinguish the genus to which they belong, though the characters of the sacrum make it probable that they belong

* I have not seen the sacrum. It is figured in Quart. Journ. Geol. Soc. vol. xxvi. pl. iii. figs. 9, 10.

to *Palæosaurus*. The vertebræ already figured are indicated by the numbers 17, 18, 19, 25, 27, and 38. The new materials show that the caudal vertebræ steadily decrease in length as they diminish in size, and that the neural spine is inclined backward, and finally disappears, though the zygapophyses persist in the smallest vertebræ preserved.

Fig. 1.

A dorsal rib of *Palæosaurus*, showing capitular and tubercular articulations. In slab no. 63 (Brist. Mus.). $\frac{1}{3}$ nat. size.

A slender dorsal rib is preserved in slab 63 (fig. 1), which shows the tubercular and capitular facets to be nearly equal, each about $\frac{3}{10}$ inch wide, and divided by a notch which is somewhat wider. The rib appears to have been directed downward, as though it were an early dorsal. The specimen numbered 32 is stouter, has larger articular facets, and a greater depth over the articulation; only about 3 inches of its length is preserved. These ribs are compressed from front to back and are flattened on the external curved surface. The fossil described as a clavicle has much the aspect of a rib.

The dorsal vertebra no. 13 Brist. Mus. has the characteristic excavation beneath the transverse process, which is margined by anterior and posterior buttresses, which diverge as they descend. The centrum is $1\frac{4}{10}$ inch long. Its articular face is flattened, with a margin slightly rounded; it is 1 inch deep and somewhat narrower. The sides of the centrum are gently concave in length, with a flattened aspect; the base is rounded from side to side. The zygapophysial processes are well developed.

No. 14 Brist. Mus. shows the anterior position of the parapophysial facet for the head of the rib. It also shows that the neural spine is compressed from side to side and elevated, though only preserved for a height of $\frac{8}{10}$ inch. Below the neural arch the centrum shows on the side a longitudinal concave impression.

No. 10 Brist. Mus. is a dorsal vertebra showing a thick vertical neural spine and strong transverse processes, which appear to be notched out in the anterior margins, as among Crocodiles.

The caudal vertebra no. 17 Brist. Mus. has the centrum $1\frac{3}{10}$ inch long, $\frac{8}{10}$ inch high in front, and $\frac{7}{10}$ inch high behind. The measurement from the hinder border of the base of the

centrum to the summit of the neural spine is $1\frac{8}{10}$ inch. It is interesting as preserving the chevron-bone in natural articulation and for showing that the posterior facet for this bone is twice as wide as the anterior facet. The proportions of the centrum are Crocodilian rather than Saurischian.

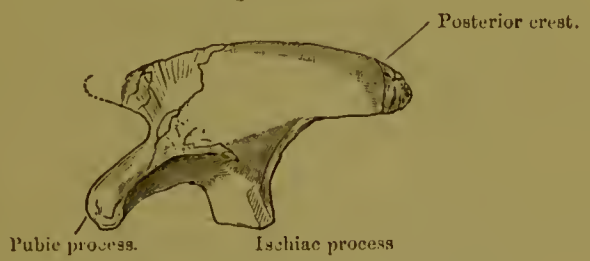
The caudal vertebra in slab 63 Brist. Mus. is $1\frac{2}{10}$ inch long. The articular faces of the centrum are about $\frac{6}{10}$ inch deep anteriorly and posteriorly. The vertebra is posterior in position to no. 17, for the transverse process has become reduced to a tubercle. The height to the summit of the neural spine is $1\frac{6}{10}$ inch. (See fig. 3, *c*.)

No. 19 Brist. Mus. includes three small caudal vertebræ in which the neural spine is lost. The centrums are each about $\frac{9}{10}$ inch long. The postzygapophyses are received between the prezygapophyses, indicating a vertical movement. The contour between the zygapophyses longitudinally is concave.

Ilium of Palæosaurus. (Figs. 2 and 3.)

The iliac bones already referred to which occur in the slab no. 63 are associated with a caudal vertebra, double-headed ribs, proximal end of a tibia, a fragment of fibula, and other remains. The anterior angle of the ilium is small and appears to be imperfect, and the posterior angle is worn. The gently convex superior crest is $3\frac{1}{2}$ inches long as preserved. Its middle part approximates towards the sacrum, owing to the

Fig. 2.



External aspect of left ilium of *Palæosaurus*.
Brist. Mus. no. 63. $\frac{1}{3}$ nat. size.

outward reflexion of the anterior angle, which makes the superior contour of the crest of the bone concave in length. The posterior angle of the crest is much more prolonged than the anterior angle, so that one half of the bone is behind the posterior border of the acetabulum. The superior and inferior edges of this process converge, but they are subparallel and

the process is about $\frac{8}{10}$ inch deep. The anterior process is indistinctly defined, and was produced somewhat forward to a point which was not in advance of the pubic process.

The acetabulum is an arch with its anterior side inclined forward at an angle of 45°; the posterior side is shorter and more vertical. The pubic process which forms the anterior border is $1\frac{3}{10}$ inch long and margins the front of the acetabulum, with a long oblique ridge.

The hinder border of the acetabulum is at first sharp, but as it ascends it is reflected upward, so as to be flattened or concave on the underside of the posterior process of the ilium. The acetabulum is perforated by an arch which is similar in contour to the external outline of the acetabulum. This specimen differs from that figured by Professor Huxley in being smaller, in a more acute notch between the anterior process of the ilium and the pubic process, in the much less excavation of the notch between the pubic and ischiac processes, in the relatively greater length of the pubic process and of the anterior process of the ilium, which characters may possibly be more than individual variation.

Fig. 3.

Natural impression from the internal surface of the right ilium of a species of *Palæosaurus*. A caudal vertebra (*c*) in the same slab is drawn posterior to the ilium. Brist. Mus. no. 63. $\frac{1}{3}$ nat. size.

An example of a right ilium on slab 63, which shows the internal aspect (fig. 3), does not display any marks of attachment to the vertebræ, resembling in this Megalosaurs rather than Crocodiles. It is as large as in an alligator about 10 feet long. There is the same large development of the posterior process of the ilium seen in all Triassic Saurischia, which is also present in existing Crocodiles, but the margins of the posterior process appear to approximate more rapidly, so as to terminate in a rounded extremity. Only the crest of the ilium is preserved, and this shows that the anterior angle was reflected outward, making the bone concave in length. All the lower portion of the ilium is indicated by a mould of the

bone which is lost, which is convex from front to back and does not show a very distinct outline between the pubic and ischiac processes. The anterior border of the ilium is convex from above downward, and the notch between it and the anterior process of the ilium is more open than in the other specimen. The bone is larger, has the pubic process stronger, and the notch between the processes evidently less excavated, so that it appears to indicate a distinct type of animal.

? *Ilium of* Thecodontosaurus.

Another type of ilium, if correctly identified, is referable to a different genus. With this type of ilium I should be disposed to associate the humerus originally figured by Riley and Stutchbury (*l. c.* pl. xxx. fig. 1) and the fragments of jaw referred to *Thecodontosaurus*. I have not seen any form of femur which could be attributed to *Thecodontosaurus*, and the bulk of the remains are referable to *Palæosaurus* both on the grounds of osteological affinity between the several parts of the skeleton and of association.

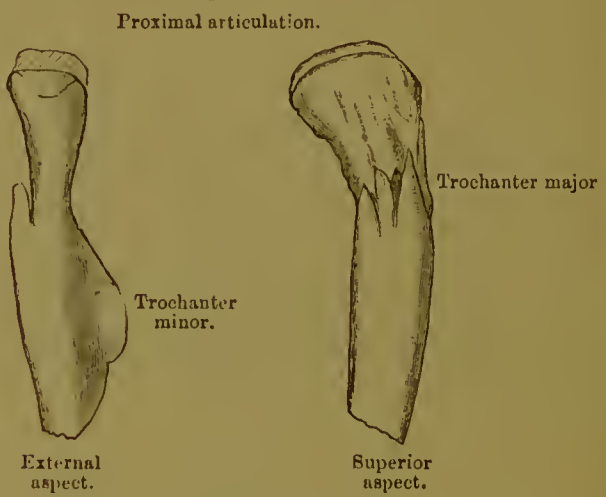
Femur of Palæosaurus. (Fig. 4.)

The femur no. 67 is the type figured by the original describers of *Palæosaurus*. As preserved it is more than 10 inches long, is exposed on the ventral aspect, and has a slight sigmoid curve. The proximal articular surface is transversely truncated and the head of the bone is convexly rounded and directed inward. The transverse measurement through the head of the bone outward is $2\frac{2}{10}$ inches; below the head the bone contracts and the lateral contour is concave. The infero-lateral trochanter, regarded as the trochanter minor, begins about 2 inches below the proximal end. It is a longitudinal plate, compressed from side to side, about 2 inches long; a slight ridge is prolonged from it down the shaft towards the inner condyle. Below the lateral trochanter the shaft becomes slightly narrower. It widens again in its lower third, where the direction of the bone is a little downward, so that the superior surface is convex. The inferior surface of the head of the bone is convex from side to side, and the inferior surface of the distal end is concave both in length and breadth. The lateral position of the trochanter minor necessarily gives an aspect of great depth in that position, and the bone has an inflated aspect at the inner side about the trochanter. The distal end of the bone is flattened on the inner side, but rounded. The transverse width at the

terminal fracture was at least $2\frac{3}{10}$ inches. The bone appears to have been reconstructed.

Many other specimens indicate portions of femora, and are catalogued under the numbers 68, 69, 72, 75, 37, 82, 89, and 99. Some of these are free from matrix and show the characters of the femur in detail.

Fig. 4.



Left femur of *Palæosaurus*. Brist. Mus. no. 68. $\frac{1}{3}$ nat. size.

No. 68 (fig. 4) is the proximal end of a femur which shows both the external and lateral trochanters. The head of the bone is compressed from above downward, flattened superiorly, and more convex on the underside. It is less directed inward than in the type, fully $1\frac{7}{10}$ inch broad, and $\frac{9}{10}$ inch thick. The internal border is concave, the external border convex. At $1\frac{7}{10}$ inch from the proximal end, where the head of the bone has contracted somewhat both in breadth and thickness, is the small external trochanter major, which is a small spur directed upward, scarcely separated from the shaft, suggesting in this respect the similar trochanter in *Zanclodon*, though in characters of the head of the bone *Palæosaurus* is less Megalosaurian. The inferior lateral trochanter is in the corresponding position to that of *Zanclodon*. It is $2\frac{4}{10}$ inches from the proximal end, and therefore less like *Dimodosaurus*. The external trochanter is much less distinctly defined than is usual in Saurischians. By means of three rugosities it extends transversely across the upper surface of the head of the bone.

No. 69 illustrates the character of the distal end*. The

* Three distinct specimens are indicated under this number.

distal condyles are rounded from back to front, flattened on the inner side, and oblique on the external border. The bone is $1\frac{8}{10}$ inch thick at the condyle. This larger condyle is separated by a concavity which extends on to the base of the articular surface from the smaller external condyle, beyond which is the oblique compressed external border of the bone. The transverse width of the distal end is $2\frac{5}{10}$ inches. The specimens of femur differ considerably in size and character; some apparently indicate bones not more than 6 inches in length and more slender than others, as though different species were mixed together.

The Tibia of Palæosaurus. (Fig. 5.)

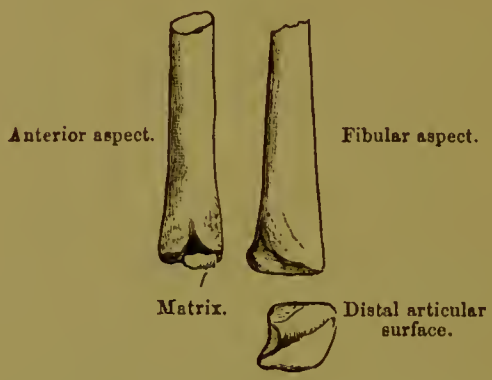
The tibia figured in 1840 still remains the only complete specimen. It is apparently in less excellent preservation at the distal end than when originally drawn, and without the aid of a second specimen its characters might have remained in uncertainty. The specimen no. 76 is 7 inches long, very slender in the middle of the shaft, and expanded at both extremities. The transverse width of the proximal end is $2\frac{3}{10}$ inches as exposed, measuring obliquely from the anterior border of the cnemial crest to the inner posterior angle of the articulation. The width of the bone behind is about $1\frac{1}{2}$ inch, and its external lateral measurement is about as much. As in the specimen 77 *a* figured by Professor Huxley, the external border has a distinct fibular concavity; but the forms of the proximal articular surfaces of the two specimens are different. The cnemial crest is elevated slightly above the articular surface for the femur. The posterior margin of the proximal femoral articulation of the tibia is rounded in the usual way, as though for contact with the condyles of the femur. The shaft is slightly more than $\frac{1}{2}$ inch wide in the middle, the distal end is $1\frac{2}{10}$ inch wide, notched on the anterior border, and has a subquadrate form.

There is a remarkable general resemblance between this bone and the tibia which I have described as *Agrosaurus* (Quart. Journ. Geol. Soc. 1891, vol. xlvii. p. 164), in which, however, the expansion of the proximal end appears to be relatively greater; and the notch at the distal end appears to be in about a line with the cnemial crest, while in *Agrosaurus* it is obviously lateral and on the fibular side.

No. 53 (fig. 5) is a fragment a little over 3 inches long, showing the distal end of a more slender tibia, in which the bone wants the transverse expansion which characterizes the type species no. 76. The distal end is subquadrate, about

$\frac{8}{10}$ inch in each measurement, and slightly oblique, as in *Agrosaurus*. It is shown to be a right tibia by the manner in which the surface from which the astragalus has become lost is excavated on its external border, as in *Agrosaurus*; so that the

Fig. 5.



Distal end of the left tibia of *Palæosaurus*. Brist. Mus. no. 53. $\frac{1}{3}$ nat. size.

astragalus must have been subquadrate, but, as in many Saurischians, deepest on the fibular border. There is an indication by an ascending groove of a small ascending talon, making some approach to *Dimosaurus*.

The tibia on slab 63 shows less than 6 inches of its proximal end, which is only 2 inches wide, and has the cnemial crest defined by a small superior cavity, which is continued downward by the fibular groove on the external aspect. The shaft of the bone is about $\frac{8}{10}$ inch wide in the middle, and appears to be expanding slightly towards the distal fracture.

The Fibula of Palæosaurus. (Fig. 6.)

A bone which I regard as being the left fibula agrees closely with the tibia in its length, is of about the same dimensions as the tibia no. 76 in the shaft, though but little expanded at the proximal and distal ends. It may have belonged to a species with rather more robust bones, such as is indicated by the slab tibia, no. 63. The distal extremity, which is exposed in lateral view, is strong and moderately expanded, like the distal end of the tibia no. 76, which it resembles in size. It has a convexly truncated distal end, which is about $1\frac{2}{10}$ inch wide. The bone is somewhat imperfect in fracture, but has a slender shaft $\frac{1}{2}$ inch wide, with subparallel sides; the oblique proximal end widens to about

1 inch, chiefly prolonged on the posterior margin. The proximal end has therefore the aspect of being inclined a little backward, and compressed at the articulation. It

Fig. 6.

Lateral aspect of the fibula of *Palæosaurus*. Brist. Mus. no. 42. ½ nat. size.

appears to be flattened from side to side. The proximal articulation appears to be at right angles to that of the distal end.

No tarsal bones are preserved.

The Metatarsus of Palæosaurus.

The metatarsus is represented by several bones. No. 79 is a left metatarsal $4\frac{1}{4}$ inches long, $\frac{18}{20}$ inch wide at the distal extremity, and $\frac{1}{2}$ inch wide above the distal articulation. Its proximal end is stout, fully an inch wide, oblique to the distal end, and inclined outward.

The type specimen is $3\frac{1}{2}$ inches long, $\frac{8}{10}$ inch wide at the distal end, $\frac{4}{10}$ inch wide in the lower third, and $1\frac{1}{10}$ inch wide at the proximal end, which, as usual, is concave on the under surface and oblique. No. 83 is a little smaller, the metatarsal being 3 inches long, with the proximal end $\frac{4}{10}$ inch wide and $\frac{9}{10}$ inch deep. These measurements are such that the bones might all belong to one foot, and they are provisionally referred to *Palæosaurus*.

The number of phalanges preserved is small; the longest, $1\frac{4}{10}$ inch long and $\frac{9}{10}$ inch wide, is a flattened bone, concave on the external border and straight on the inner border. Its articular surfaces are particularly well ossified, and rounded distally in pulley shape, like those of the metatarsal bones. Another phalangeal bone is $1\frac{1}{10}$ inch long. These measurements are in harmony with those usual in allied animals. I have nothing to add to the account of the claw-phalanges given by Riley and Stutchbury.

No. 87 is compressed from side to side, is about 2 inches long, and presents a type very similar to the claws of *Dimodosaurus*, but less wide.

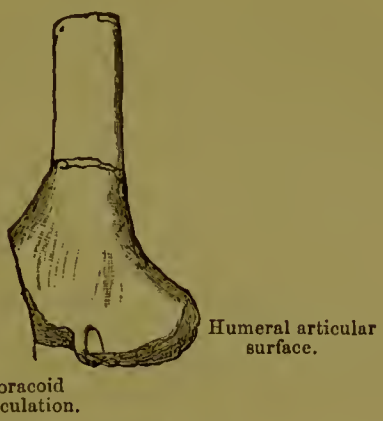
From the close similarity of form which these metatarsal and phalangeal bones offer to the bones of the foot in Crocodiles, I am led to believe that the animals were plantigrade. The ease with which a joint is made by the astragalus does not seem to necessarily imply a vertical position for the metatarsus, although that pulley-joint is found in birds. The metatarsus of most birds is not adapted for application to the ground in the same way as the wide metatarsus formed of separate bones which is found in these Saurischia.

The Shoulder-girdle in Palæosaurus.

Various examples of the scapula and coracoid occur, but they are all very imperfect. The principal specimens are numbered 89, 90, 91, 97, 59. Notwithstanding the imperfection of preservation, there is no doubt that the scapula was comparatively slender and short. It expanded a little at the free end, had both the anterior and posterior margins concave, widened greatly towards the coracoid, where it extended transversely forward. The different specimens vary a good deal in the width of the shaft. One of the smallest specimens, no. 90, very imperfect on the anterior coracoid end, and obviously broken at the extremity of the blade, is 6 inches long. As preserved the coracoid end is 2 inches wide, with an indication of a notch in the middle, which I take to mark the limit of the foramen towards the articular portion of the bone. The blade narrows in the middle to $\frac{9}{10}$ inch, and expands towards the free end, probably to more than $1\frac{1}{2}$ inch. No. 91, which has the form of the blade of a scapula, is 1 inch wide in the narrow part and 2 inches wide at the free extremity. It, however, shows no indication of the proximal end, and I cannot affirm that the bone is certainly a scapula, for its form is not unlike what might be expected in the blade of a pubis.

No. 97 is an instructive fragment (fig. 7), showing the articular end of the scapula in an uncompressed condition.

Fig. 7.



Scapula of *Palæosaurus*. Brist. Mus. no. 97. ½ nat. size.

The principal specimen, no. 89, is exposed on the internal aspect, and consequently shows no indication of the articular surface and only a slight film of the coracoid and a portion of the impression from which the bone is lost. The scapula is concave in length on the posterior surface, with a sharp anterior border, which was reflected outward in the region in which the thickening of the anterior crest of the scapula is usually found. The bone does not appear to have been more than $5\frac{1}{2}$ inches long; it is $1\frac{1}{2}$ inch wide towards the free end, 1 inch wide in the middle, $2\frac{7}{10}$ inches wide towards the humeral articulation; but it is fractured in front, and probably had a width of $3\frac{1}{2}$ inches. The coracoid is very imperfectly indicated in this and the other specimens in which it appears to be partially preserved. The substance of the coracoid is $\frac{3}{20}$ inch thick, which is only half the thickness of the fractured anterior margin of the scapula. There is some indication that the surfaces of scapula and coracoid, which contributed to make the articulation for the humerus, met each other at an angle. Both these surfaces exceed an inch in length. There is a slight eminence on the surface on the cast in the region of the coracoid, which may indicate a foramen. It seems probable that the scapulæ here referred to belong to different species; and it might be anticipated that *Palæosaurus* will have a comparatively large and strong articulation in the shoulder-girdle when compared with *Thecodontosaurus*. It is possible that the bone no. 90 may pertain to the latter genus

if it is to be regarded as scapula, while 89 and 97 may be referred to *Palæosaurus*.

Humerus of Thecodontosaurus.

The specimens 95 and 96 are portions of the same bone, and are the type of the humerus of *Thecodontosaurus*, which is remarkable for the comparative straightness of its inner side, the concavity of its external border, and the relatively small proximal expansion given to the bone by the radial crest, which appears to be equalled by the width of the distal end, though the radial crest is imperfectly preserved. This humerus is remarkably flattened, and has the proximal and distal articulations in the same plane. The bone is exposed, so as to show the superior surface at the proximal end, and the inferior aspect at the distal end. The bone is much straighter, less twisted, more expanded transversely at the distal end, and less expanded in the radial crest than any Saurischian humerus known to me; and it differs in all these characters from the other humeri found in the same deposit. The length of the bone is $6\frac{1}{2}$ inches; the least width of the shaft, $\frac{6}{10}$ inch, is above the middle. The greatest width of the articular part of the head of the bone exceeds an inch; the head is slightly tumid and directed upward; while the radial crest, which is not conspicuously separate from the shaft, increases the width on the radial side to about 2 inches. There appears to have been a smooth, sharp, short margin between the articular head and the compressed vertical tuberosity of the outer border of the crest, which was about $\frac{1}{2}$ inch long.

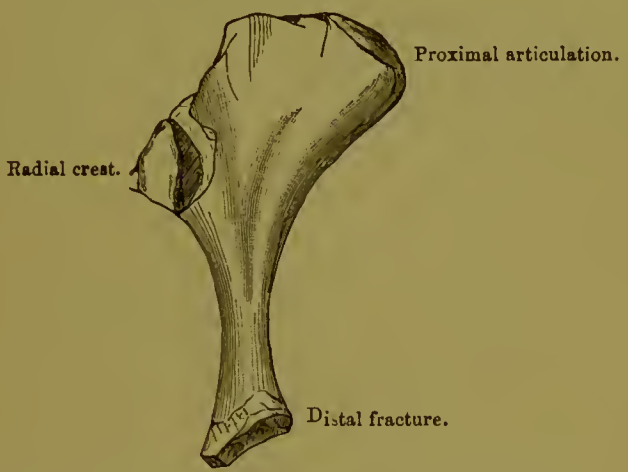
The distal end widens to about $2\frac{2}{10}$ inches. The external margin is prolonged in a convex curve on to the distal margin. The distal articular surface is concave from side to side, and therefore saddle-shaped, seeing that it is rounded from above downward. Above the articular surface the bone is slightly impressed, as though by the ulna. The contours of the bone at first sight approximate to those of *Belodon*; but the resemblance is superficial, since in that genus it is the internal border of the bone which is concave and the external which is nearly straight. There can be no doubt that, in so far as the bone diverges from ordinary Saurischia, it approaches towards existing Lizards.

Humerus of Palæosaurus. (Figs. 8 and 9.)

Besides the Thecodont type, there is the badly preserved bone originally described as ischium, which is a large right

humerus. It has lost both proximal and distal ends, but has the radial crest preserved, showing a type in which the proximal end of the bone was greatly expanded relatively to the distal end; and this type conforms to the Saurischian plan. It is very well represented by the humerus 118, which is similarly imperfect distally and has lost the radial crest, but preserves the articular head. The right humerus no. 37 also has the articular head and radial crest imperfect, but preserves the distal end of the bone. These specimens appear to be referable to more than one species; but the plan of the bone is the same in them all, so that an idea of the form of the humerus in *Pulæosaurus* may be gathered from them.

Fig. 8.



Inferior aspect of a right humerus of *Palæosaurus*, showing the proximal articulation; imperfect distally. Brist. Mus. no. 118. $\frac{1}{3}$ nat. size.

The transverse width of no. 66 at the base of the radial crest is $3\frac{1}{2}$ inches; but since the head of the bone is broken away, the transverse measurement was probably not less than 4 inches. The shaft is $\frac{7}{8}$ inch thick, and the compressed tuberosity of the radial crest is $1\frac{8}{10}$ inch long. The large radial crest extends for a considerable distance down the length of the shaft, and the length of the bone, of which indications are preserved, amounted to 7 inches, without evidence of the extremity of either proximal or distal end.

No. 118 is a smaller bone (fig. 8), with a transverse width of the shaft of about $\frac{6}{10}$ inch, which is similar in size to no. 37. The complete proximal outline of the articular head is convex. The head is directed inward at an angle of 45° to the length of the shaft, and appears also to be twisted at an angle of 45° to

the distal end. It is about $1\frac{1}{2}$ inch long. Beyond this articular surface the unusually expanded radial crest is exposed, so that it is reflected downward, forming an open angle with the head. The measurement from the inferior border of the radial crest to the proximal articular surface is $3\frac{1}{2}$ inches, and the extreme width of the proximal end, as preserved, $3\frac{3}{4}$ inches. This expanded proximal surface is concave from side to side, with a median depression prolonged distally till it passes into the ridge which divides the distal end into a narrow oblique internal area, and a wide flattened external area, inclined to the inner surface at a great angle. The proximal articular surface, compressed from above downward, becomes narrower from within outward, and appears to have much the same relation to the radial crest as the corresponding parts of the humerus in Crocodiles. The radial crest at its outer inferior border is fully $\frac{3}{10}$ inch thick, and the length of its inferior border, as preserved, is about $2\frac{7}{10}$ inches. At the distal fracture the bone is about $1\frac{1}{10}$ inch wide and $\frac{3}{10}$ inch thick, and thickest on the inner border.

Fig. 9.

Right humerus of *Palæosaurus*, showing part of the distal articulation; the proximal end is imperfect. Brist. Mus. no. 37. $\frac{1}{3}$ nat. size.

No. 37 (fig. 9) appears to indicate the length of the bone as being $6\frac{1}{4}$ inches, with the articular ends less perfectly ossified than in *Thecodontosaurus*; the large radial crest is prolonged for about halfway down the length of the humerus. There appear to be two condyles at the distal end, which measure about $1\frac{8}{10}$ inch from side to side as preserved. There is a

concavity above the distal condyles, and the bone has a compressed aspect on this inferior surface. The condyles are rounded, moderately developed; the internal condyle is broken. The bone has the usual slight sigmoid curve; it thickens towards the proximal articulation. The measurement from the proximal articular surface to the inferior angle of the radial crest is $3\frac{3}{10}$ inches. This bone is similar to the humerus of *Zanclodon* figured by Plieninger in all its characters, except that its radial crest appears to have a rather greater transverse width.

Ulna. (Fig. 10.)

A specimen, no. 46 (fig. 10.), originally figured by Riley and Stutchbury as the tibia, may be the ulna of *Palæosaurus*. The absence of curvature in the bone is not opposed to its being so identified, and the development of the proximal olecranon process is an approximation to *Pareiasaurus*, which is also found in *Stegosaurus* (Marsh, Am. Journ. Sci. vol. xix. pl. viii. fig. 3).

Fig. 10.

Lateral aspect of the ulna. Brist. Mus. no. 46. $\frac{1}{3}$ nat. size.

The ulna is about $4\frac{8}{10}$ inches long, concave on the anterior and posterior outlines, $1\frac{1}{10}$ inch wide, with the distal end convex from front to back, without sign of excavation of the distal end.

The proximal end is $1\frac{1}{2}$ inch wide, with the articular surface slightly concave from front to back, margined by a distinct anterior edge like that seen in other examples of the Saurischian ulna, with the articular surface inclined to look upward and forward. There is a wide compressed

olecranon crest, which extends proximally above the articulation, somewhat like the cnemial crest of the tibia in *Dimodosaurus*. The middle of the shaft is ½ inch wide. On the supposition that the specimen is exposed on its internal aspect, the condition of the distal end would present nothing remarkable. The relative shortness of the bone as compared with the humerus of *Palæosaurus* seems to me in harmony with what might be expected from the known proportions of the fore and hind limbs.

The only element of the fore limb, besides the ulna, which can be recognized with any probability is a small metacarpal, which is much more slender than the metatarsal bones and more perfectly rounded at the distal extremity, and it is shorter.

In all parts of *Palæosaurus* which can be compared with *Zanclodon*, such as the ilium, humerus, femur, and scapula, there is a strong resemblance, though the differences are marked in the tibia and details of the femur, especially the distal end, so that it does not follow that the pubis and ischium were quite the same in both generic types. The proportions of *Palæosaurus* appear to have been those of a Crocodile, though the tail was probably shorter. The femur may be taken at 10½ inches long and the tibia at 7 inches; so that it is difficult to believe that the body of the animal was lifted off the ground by the limbs. The humerus is 7 inches long and the ulna nearly 5 inches long. The Crocodilian character and size of the ilium are remarkable in relation to this shortness of the limbs, as showing persistence of character in the iliac bone, and presumably of habit in the animals thus characterized.

I desire to thank Mr. Swayne and Mr. E. Wilson for the facilities afforded me in examining the collection of bones in the Bristol Museum.

After these notes on English Triassic Saurischia were written and in the hands of the Geological Society of London, Professor Marsh published notes on Triassic Dinosaurs in the 'American Journal of Science' in June 1892. The text which refers to the Bristol specimens is limited to a few lines; the fossils being classed under the genus *Thecodontosaurus*, which is compared with the American genus *Anchisaurus*.

Professor Marsh figures the base of the skull of [*Thecodontosaurus*] *platyodon*, of which no example is known in this country in any museum.

Figures are also given of the bones of the left fore leg of the same species, in which are shown the scapula and coracoid, the humerus, radius, ulna, two carpal bones, and five metacarpals. There are three digits bearing claws with two, three, and four phalanges; the fourth digit has three minute phalanges, and in the fifth a hypothetical phalange is indicated. The claws decrease in size from the first to the third. No such specimen exists in this country. The forms of the bones are similar to those which I have attributed to *Palæosaurus platyodon*, with which they correspond in proportion, though, as the figure is one-fourth natural size, the animal appears to be slightly smaller than that of which I have given particulars. It is unexpected to find so Crocodilian a type of limb with the metatarsals extended as though they were carried vertically.

As the Bristol Museum specimens all came from a working long since closed, it would be interesting to learn the source from which these important new materials have been obtained.